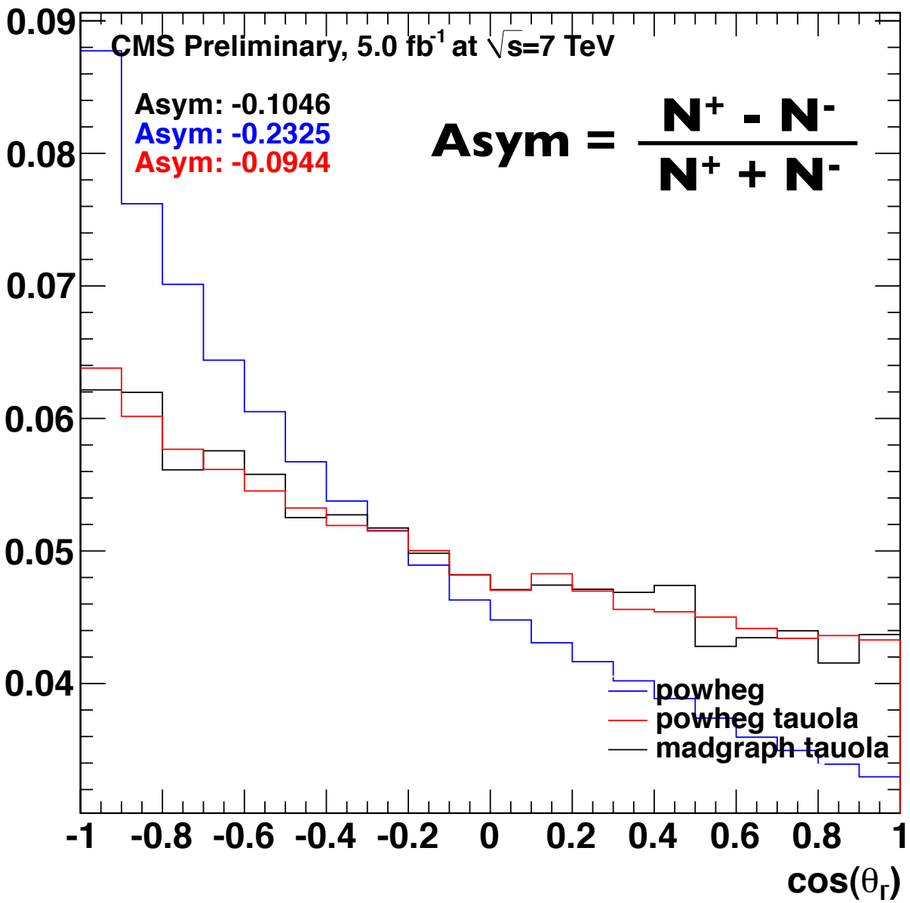
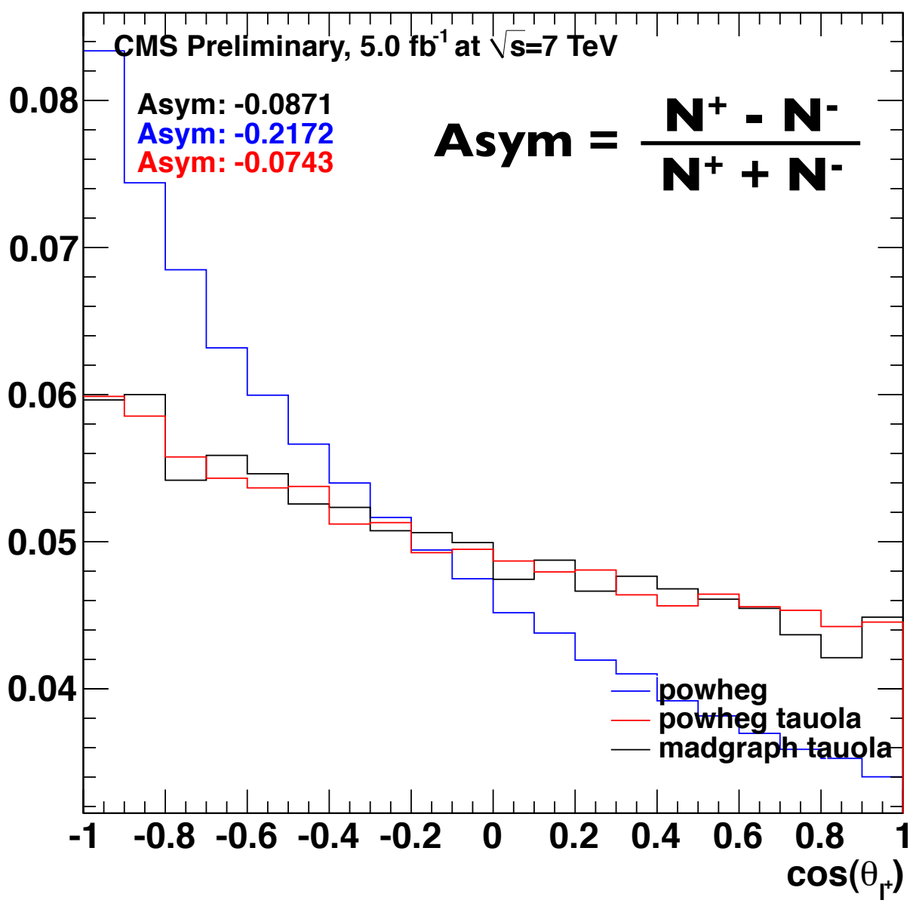
- all taus (anti-taus) should be left (right) handed because they come from W decay, i.e. P ~= -1 (+1)
- we concluded in our meeting with Martijn, Ian, and Piergiulio that tauola ignores the tau polarisation (at least this was my impression *)
- this should give isotropic tau decay, so I have plotted cosTheta between the status 1 lepton (from tau decay) and the direction of the status 3 parent tau's boost in the parent's tau CM frame. The tauola samples don't give flat distributions for some reason, but they are consistent between madgraph and powheg (note these plots are independent of any spin correlation effects). The non-tauola sample gives a steeper slope.
- it looks like tauola doesn't completely ignore the polarization, but the non-tauola sample does things very differently!
- expect $\frac{d\Gamma(l^{\pm})}{d\Omega dx} = \frac{G^2 m_l^5}{192\pi^4} x^2 \{3(1-x) + \frac{2}{3}\rho(4x-3) + 6\eta\frac{m_e}{m_l}\frac{1-x}{x} \pm \xi P_l \cos\theta[1-x+\frac{2}{3}\delta(4x-3)]\}$, integrating gives $\frac{d\Gamma}{d\cos\theta} \sim 1 \pm \frac{1}{3}P_\mu \cos\theta.$
  $\rho = \delta = \frac{3}{4}$, $\xi = 1$, and $\eta = 0$.
  - expect more daughter leptons at high cosTheta (i.e. positive slope), but plots show the opposite





- To estimate the systematic uncertainty we intend to reweight the MC to give the correct cosTheta distribution. Is it correct to use the above equations?
  - need to understand the shapes we see in the plots on the left first

* This information from Martijn suggests that in fact tauola doesn't completely ignoring the tau polarisation:
6) from Ian Nugent (maintaining the Tauola interface) I understand Taula does _not_ preserve spin correlations for ttbar ... although it could propagate polarisation.

- On the previous slide we saw the two powheg samples (using tauola or just pythia for the tau decay) have very different cosTheta distributions for the status 1 charged lepton from the tau decay, so comparing the two samples could give an idea of the systematic uncertainty from incorrect modeling of the cosTheta distribution.
- Plots show Δphi between the two leptons at parton level for the 2 different powheg samples. No cuts are made except that each event must be dileptonic ttbar with at least one tau. The two samples look the same at status 3 (as we expect, because at this stage they are the same), but also the same at status 1 => expect systematic will be small.
  - decayed taus: histogram is filled using the status 1 tau daughter electron or muon
  - undecayed taus: histogram is filled using status 3 taus (in both cases status 3 e and μ are used)